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ABSTRACT

Intended primarily but not solely for use at the postsecondary level, this curriculum guide contains five units on energy efficiency that were designed to be incorporated into an existing program in heating, ventilating, and air-conditioning. The following topics are examined: how energy conservation pays, heating, ventilation, air-conditioning, and new appliance purchasing. Covered in each unit are unit rationale, necessary advanced preparations, anticipated instructional time, guidelines for implementing the unit, unit activities, and unit references. (MN)

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ENERGY EFFICIENCY
FOR
HEATING, VENTILATING, AIR-CONDITIONING INSTRUCTORS

co-edited by:

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CE 033356

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PREFACE

This curriculum guide was produced by the Nebraska Energy Office in a cooperative effort with the Nebraska State Department of Education. These organizations are dedicated to the development of quality educational materials that promote wise energy management.

The following individuals assisted in the production of these materials:

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These materials will be piloted during the 1980-1981 school year, revised, and subsequently made available statewide in the 1981-1982 academic year.

All inquiries, suggestions, or comments regarding this curriculum guide should be directed to:

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INTRODUCTION

This curriculum guide contains five units that were designed to be incorporated into an existing program of heating, ventilating, and air-conditioning instruction. The material is primarily intended for use at the post-secondary level. A well-equipped secondary instructor, however, will also find the information useful.

The five units may be taught independently or collectively depending on the needs of the instructor at any single institution. The content of these units has been written and organized into an outline format. Each unit outline, in order to facilitate articulation between units, consists of the following sections: rationale, advanced preparation, anticipated instructional time, unit guide, activities, and references.

The degree of coverage depth, instructional time, and evaluation of student performance are left at the discretion of the individual instructor. Suggested activities are included but are by no means comprehensive. Instructors should feel free to add, delete, or substitute activities, references, and audiovisual materials. The Nebraska Energy Office encourages innovation to best suit the needs of the individual instructor.

The overall objective of this curriculum guide is to provide the HVAC instructors in Nebraska with a format to achieve continuity in their approach to teaching energy efficiency for heating, ventilating, and air-conditioning.

Course Rationale

This course is designed to promote the understanding and application of some important energy conservation practices in HVAC systems. It is our intent to provide the student with sufficient information to expand his/her working knowledge beyond maintenance and operation. A thorough understanding of the principles discussed in the units to follow, will allow the student to maximize the potential energy efficiency of HVAC systems.

The principle HVAC energy conservation practices are discussed in the following units:

1. How Energy Conservation Pays - presents an overview of residential energy use and methods for reducing residential energy costs.

2. Heating - deals with the various ways to conserve energy with regard to heating.

3. Ventilation - provides information concerning ventilation for energy conservation without sacrificing safety or comfort.

4. Air-Conditioning - deals with the various ways to conserve energy with regard to present and future air-conditioning appliances.

5. New Appliance Purchasing - is designed to provide information concerning what to look for when purchasing a new appliance (in relation to energy conservation).

Although this guide is designed to promote energy conservation principles, conservation alone will not solve our present or future energy problems. Continued conservation, sound energy management, and technological improvements will, however, buy our nation precious time until self-sufficiency based on alternate energy sources becomes feasible.

UNIT I

HOW ENERGY CONSERVATION PAYS

RATIONALE

Most of our residential energy, 70 percent, is used to heat and cool our homes. An additional 20 percent goes for heating water, the second largest home energy user and expense. The remaining 10 percent goes into lighting, cooking, and running small appliances.

We can cut our energy use and help control living costs by making our homes energy efficient, even if we have to spend money to do it. The money we spend now, however, can help hold down energy costs for many years to come.

This unit is designed to explain various residential energy saving tips in relation to HVAC systems.

ADVANCED PREPARATION

It is recommended that the publications "Tips for Energy Savers" and "Nebraska Energy Saving Manual" be obtained from the Nebraska Energy Office prior to beginning this unit.

ANTICIPATED INSTRUCTIONAL TIME

1-3 weeks

UNIT GUIDE

1. INSULATE

   A. Find out if your home needs insulation.
   B. Determine the R-value desired and most cost/effective.
   C. Insulate or increase the amount of insulation in your attic floor or top floor ceiling.
   D. Don't insulate over eave vents or on top of recessed lighting fixtures or other heat-producing equipment on the attic floor.
   E. Consider insulating exterior walls. Savings could amount to 16-20 percent of utility costs.
   F. Insulate floors over unheated spaces (such as crawl spaces and garages).

2. DRAFT-PROOF WINDOWS AND DOORS

   A. Test your windows and doors for airtightness.
   B. Caulk and weatherstrip doors and windows.
   C. Install storm windows.

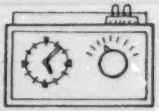
3. HEATING AND COOLING - During both heating and cooling seasons...

   A. Close off unoccupied rooms.
   B. Use kitchen, bath, and other ventilating fans sparingly.
   C. Keep your fireplace damper closed unless you have a fire going.

4. HEATING ENERGY SAVERS

   A. If you use electric furnace heating, consider a heat pump system.
   B. If you plan to buy a new gas heating system, ask you gas utility or public service commission about the savings potential of electronic ignition.
   C. Consider the advantages of a clock thermostat for your heating system.
   D. Consider buying a properly sized furnace that incorporates an automatic flue gas damper.
   E. Insulate heating ducts in unheated areas.
   F. Don't use your fireplace for supplemental heating when your furnace is on unless you take one of the measures suggested below to lessen the loss of heated air from the house.

   G. Lessen heat loss if you use your fireplace when the furnace is on:



-Lower the thermostat setting to between 50°F and 55°F.
-Close all doors and warm air ducts entering the room with the fireplace, and open a window near the fireplace about 1/2 to 1 inch.
-If you have a simple open masonry fireplace, consider installing a glass front or a glass screen.

   H. When the heat is on:

-Lower your thermostat to 65°F during the day and 55° at night.
-Keep windows near your thermostat tightly closed.
-Have your oil furnace serviced at least once a year.
-Clean or replace the filter in your forced-air heating system each month.
-Check the duct work for air leaks about once a year if you have a forced-air heating system.
-If you have oil heat, have your service man check to see if the firing rate is correct.
-Don't let cold air seep into your home through the attic access door.
-Dust or vacuum radiator surfaces frequently.

-Keep draperies and shades open in sunny windows; close them at night.
-For comfort in cooler indoor temperatures, use the best insulation of all--warm clothing.

5. COOLING ENERGY SAVERS

A. If you need central air-conditioning, select a unit with the lowest suitable capacity and highest efficiency.
B. Make sure the ducts in your air-conditioning system are properly insulated.
C. If you don't need central air-conditioning, consider using individual window or through-the-wall units.
D. Install a whole-house ventilating fan in your attic or in an upstairs window to cool the house when it's cool outside, even if you have central air-conditioning.

E. When you do use air-conditioning:

-Set your thermostat at 78°F.
-Don't set your thermostat at a colder setting than normal when you turn your air-conditioner on.
-Set the fan speed on high except in very humid weather.
-Clean or replace air-conditioning filters at least once a month.
-Turn off your window air-conditioners when you leave a room for several hours.
-Consider using a fan with your window air-conditioner.
-Don't place lamps or TV sets near your air-conditioning thermostat.

F. With or without air-conditioning:

-Keep out daytime sun.
-Keep lights low or off.
-Do your cooking and use other heat-generating appliances in the early morning and late evening hours whenever possible.
-Open the windows instead of using your air-conditioner or electric fan on cooler days and during cooler hours.
-Consider turning off the furnace pilot light.
-Dress for the warmer indoor temperatures.

G. If you are without air-conditioning:

-Be sure to keep windows and outside doors closed during the hottest hours of the day.
-Use window or whole-house ventilating fans to cool the house when it's cool outside.
-Use vents and exhaust fans to pull heat and moisture from the attic, kitchen, and laundry directly to the outside.

6. ENERGY-EFFICIENCY RATIOS FOR AIR-CONDITIONERS

If you're in the market for a room air-conditioner before the new labels are in place, you should be aware of the Energy Efficiency Ratio numbers that were developed for these appliances during an earlier voluntary appliance labeling program. They still may be in use in your community.

The Energy Efficiency Ratio (EER) is a number that rates the energy efficiency of similar appliances. The higher the EER number, the more efficient the appliance.

Example: EER's for room air-conditioners can be as low as 5.4 and as high as 11.5. The 11.5-rated room air-conditioner is more than twice as efficient as the 5.4 unit of the same capacity and uses less than half the electrical energy.

UNIT ACTIVITIES

1. To promote awareness, the student should become familiar with potential sources of residential energy losses. Using pages 26-30 of the Nebraska Energy Saving Manual as a guide, have the student run a preliminary home energy audit.

2. A preliminary audit could also be conducted on the school building.

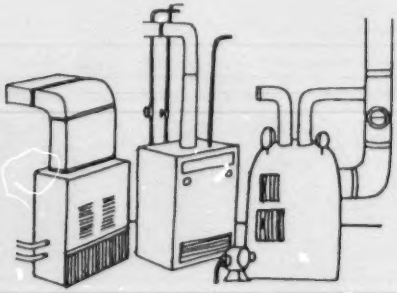
UNIT REFERENCES

1. Nebraska Energy Saving Manual
Nebraska Energy Office @ .50 per copy
P. O. Box 95085
Lincoln, NE 68509

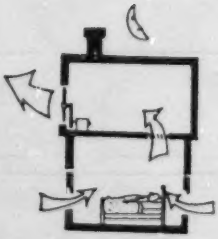
2. Tips for Energy Savers
Nebraska Energy Office (Free on request)
P. O. Box 95085
Lincoln, NE 68509

FILMS/AUDIO-VISUAL MATERIALS

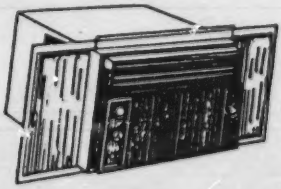
"Project Retro-Tech - Unit One - Home Weatherization"
Nebraska Energy Office
P. O. Box 95085
Lincoln, NE 68509



HEATING - UNIT II



VENTILATION - UNIT III



AIR CONDITIONING - UNIT IV

UNIT II

HEATING

RATIONALE

This unit is designed to provide the student with information concerning various ways to conserve energy with regard to heating. This will include a discussion of present and future heating appliances and some sources of alternate energy.

ADVANCED PREPARATION

It is recommended that the publication "Nebraska Energy Saving Manual" be obtained from the Nebraska Energy Office prior to beginning this unit.

This unit may require the availability and use of a combustion testing instrument kit.

ANTICIPATED INSTRUCTIONAL TIME

1-3 weeks

UNIT GUIDE

I. ELECTRIC HEAT

A. Proper sizing
   1. Run a heat loss calculation on the conditioned space.
   2. If needed, adjust the output of the existing furnace.
   3. Select a properly sized new furnace.

B. Staging thermostats
   Thermostats that are supplied with your heating equipment are usually adequate for their basic job. However, they may not include the extra refinements to match the residential structure. If you are dealing with a system of zone control (see #1-G of this unit) you may want to select a specific type of thermostat for each zone.

   1. Two-stage inside thermostat
   2. Outside thermostat

C. Preventive maintenance according to manufacturers' specifications
   1. Oil all motors and adjust fan speed.
   2. Clean or replace filters.

3. Clean fan blades.
4. Adjust thermostat.
5. Clean baseboard heaters.

D. Insulate ducts
1. When ducts run through unheated space such as an attic, crawl space or unheated basement, they should be insulated with a vapor barrier-type insulation.

E. Vapor Barrier
1. All outside walls should have a vapor barrier on the heated wall side of the insulation to prevent moisture migration through the insulation. (Moisture migration decreases the material's insulating capacity.)

F. Humidification
1. Electric heating, in most cases, does not need additional humidification because of moisture produced by cooking and bathing.

G. Zoning
1. Individual temperature control
a. Baseboard heat with individual thermostats in each room.
2. Motorized dampers with thermostats in each zone.
3. Panel-electric with control in each room.

2. GAS HEAT

A. Proper sizing
1. Run a heat loss calculation on the conditioned space.
2. If needed, adjust the output of the existing furnace.
3. Select a properly sized new furnace.

B. Conservation with flue gas dampers
1. Install new furnaces with flue gas dampers.
2. Contact qualified technician for Retrofit Kit to be installed on your present furnace.
3. Contact qualified technician for installation of Thermomaster, or Thrifty Vent Kit. (There may be other products available with this function.)
4. Have a qualified technician check the proper operation of the above.

C. Pilotless ignition
1. Install a pilotless ignition on the furnace.
2. Contact qualified techician to install a Retrofit Kit for pilotless ignitions.
3. Annually check the operation of the above.

D. Install duct insulation into unconditioned spaces by using vapor barrier-type insulation.
E. Install a day/nite setback thermostat.
   1. Have qualified technician explain recommended times and settings.
F. Check duct sizing
   1. Install the correct size ducts (if necessary).
G. Clean burners, fans, ducts, and filters. Oil motors and adjust fan speed.
H. Run combustion efficiency tests.
   1. Stack temperature test.
   2. Draft test.
   3. Make necessary adjustments.

3. OIL HEAT

A. Proper sizing
   1. Run a heat loss calculation on the conditioned space.
   2. If needed, adjust the output of the existing furnace.
   3. Select a properly sized new furnace.
B. Combustion efficiency check
   1. Check over fire draft.
   2. Check stack temperature.
   3. Check flue gas for CO_2.
   4. Check combustion chamber for cracks.
   5. Check oil pressure - 100 to 120 lbs.
   6. Use a properly sized nozzle with the correct spray angle.
   7. Check electrodes for proper setting.
   8. Smoke test.
   9. Make adjustments where necessary, on all above items.

C. Preventive maintenance (According to manufacturers' specifications)
   1. Oil all motors.
   2. Clean or replace filters.
   3. Clean fan blades.
   4. Check belt-drive tension.
   5. Change oil filter.
   6. Check oil line for leaks.
D. Fuel
   1. Number One fuel oil is heavier and has more BTU's per gallon but may cause flow problems in colder areas.
   2. Number Two fuel oil is lighter and has less BTU's per gallon but is less apt to cause flow problems. This is the most common fuel for residential use.

4. HEAT PUMPS

A. Duct Sizing
   1. The slower air velocity maintained in a heat pump system requires larger ducts.

B. Air-to-Air
   1. Air-to-air heat pumps remove heat from the outside ambient air and transfer it to the conditioned space using a reverse cycle refrigeration system (with refrigerant as the transfer medium).

C. Water-to-Air
   1. Water-to-air removes heat from water using a reverse cycle refrigeration system (with refrigerant as the transfer medium).

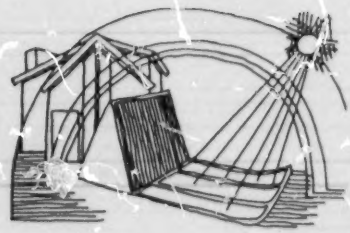
D. Thermostat staging
   1. Two-stage inside heating thermostats
      In heat pump applications using a two-stage thermostat, the first stage activates the reversing valve, the compressor contactors, and the fan relay thus putting the unit in the heating mode. As the temperature drops and the heat pump cannot keep up with the desired temperature the second stage then activates the heating relay in the furnace bringing on the electric resistance heaters used to supplement the heat pump.
   2. Outside staging thermostats
      Only the necessary heating elements are called upon to heat the conditioned space by sensing outside air temperature. This can result in more comfort and less energy consumption.

E. COP Rating - (Coefficient of Performance)
   1. The COP rating goes down as the ambient temperature drops on air-to-air systems.
   2. Determine whether air-to-air or water-to-air is best suited for your area.

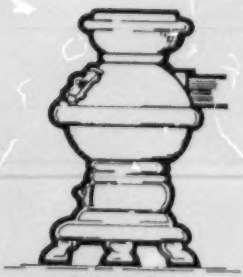
5. ALTERNATE HEAT SOURCES

A. Solar - as energy costs increase, consumers are becoming more concerned about heating their homes as economically as possible. One approach to lowering heating expenses is to retrofit homes to utilize the energy of the sun for space or domestic water heating. Some factors to consider are:
   1. Climate and orientation of the homes.
   2. Insulation.
   3. Siting and Location of Collectors
      a. flat plate
      b. evacuated tube

c. Concentrator (parabolic collection)
d. photovoltaic cells
4. Heat storage and transfer.
5. Active versus Passive systems
   a. Active - requires sophisticated mechanical equipment to collect, store, and distribute solar energy.
   b. Passive - uses solar energy naturally to supplement conventional heating systems.
      1. House orientation - locate the house with the long axis running east and west, rather than north and south. This allows for maximum exposure to the south sun in winter and minimizes cold blasts from the northwest winds.
      2. Double-glazed windows/window placement.
      3. Solar greenhouse (southern facing)
      4. Roof atrium.
      5. Planting trees and windbreaks.
      6. Black-painted barrel, brick or concrete walls.



B. Wood - There is more to heating with wood than just buying a wood stove, tossing in a few logs, and starting a fire. It is certainly not difficult to make effective use of wood burning appliances, but it is important to take care in selecting a wood burning system, the wood to use, and the way to burn it.



Antique Pot Belly

The wrong type of system can give very little heat and possibly an overall heat loss! Incorrect wood burning procedures can create serious safety hazards, leading to potentially disasterous fires.
1. Add on wood-burning unit to your existing furnace.
2. Combination wood- or coal-burning with gas or oil-burning furnace.
3. Space heating wood-burning stoves.
4. Wood-burning fireplace with some kind of heat exchanger.

UNIT ACTIVITIES

1. For a complete heating unit:
   A. Run an efficiency check (See pages 140-156 of the Nebraska Energy Saving Manual).
      1. Gas-fired furnace
      2. Oil-fired furnace
   B. Perform a complete maintenance check.

2. Run a heat loss check on an existing dwelling including insulation type, thickness, and R-value. Have students make recommendations based on data collected.

UNIT REFERENCES

The following titles can be obtained from the
Nebraska Energy Office
Box 95085
Lincoln, NE 68509

1. Nebraska Energy Saving Manual 50¢ per copy
2. How to Improve the Efficiency of Your Oil-Fired Furnace
3. Get the Most from Your Heating Oil Dollar
4. How to Lower Your Energy Bills
5. How to be Energy Safe at Home
6. Energy Conservation with Heat Pumps
7. Tips for Energy Savers
8. Passive Solar - Simple Ways to Capture Free Energy
9. Burning Wood! Saving Energy and Enjoying It
10. Burning Wood! The Safe Way to Install and Use Your System
11. Wood Stove Safety
12. 65 Ways to Save Natural Gas

Other references:

Heating - Total Home Comfort (Book 1)
Honeywell Merchandising Division
Department #118
2701 Fourth Avenue South
Minneapolis, MN 55408

Bacharach Combustion Testing Instrument Kits
Bacharach Instrument Company
625 Alpha Drive, RIDC Industrial Park
Pittsburgh, PA 15238

Solar Fact Sheets #FS110, FS112, FS117
National Solar Heating and Cooling Information Center
P. O. Box 1607
Rockville, MD 20850 (800) 523-2929

From Whirlpool Corporation, Benton Harbor, Michigan:

1. Servicing Gas-Fired Heating Equipment, HS-9
2. Servicing Oil-Fired Heating Equipment, HS-10
3. Servicing Electric Heating Equipment, HS-11
4. Servicing Packaged Central Gas Heating and Electic Cooling Systems, HS-12

From Bryant Air-Conditioning and Heating Company, Lincoln, NE (402) 467-1111

1. Pilotless Ignitions
2. Flue Dampers

Introduction to Solar Heating and Cooling Design and Sizing U. S. Department of Energy DOE/CS-0011, August 1978 Washington, D.C. 20545

UNIT III

VENTILATION

RATIONALE

In the summer the sun's heat adds a large radiant heat load to the air-conditioning system. This heat will build up and be stored even through a cool summer night. Radiant heat plus stored-up heat means high summer air-conditioning bills plus strain on all components of the air-conditioning system. Adequate ventilation of attic spaces can dramatically reduce both factors and lead to longer life for the air-conditioning system and reduced bills for electricity.

This unit has been designed to present ventilation for energy conservation without sacrificing comfort or safety.

ADVANCED PREPARATION

The slide/tape series, Weatherization: Skill Training Series Parts I and II should be reserved for use during this unit. It has been provided by the Nebraska Energy Office to each Community College Area. Check with your media services to obtain the series.

ANTICIPATED INSTRUCTIONAL TIME

1-2 weeks

UNIT GUIDE

1. INFILTRATION (negative pressure)

   A. Explain how infiltration comes through cracks around doors, windows, foundations and down flue pipes.

2. EXFILTRATION (Positive pressure)

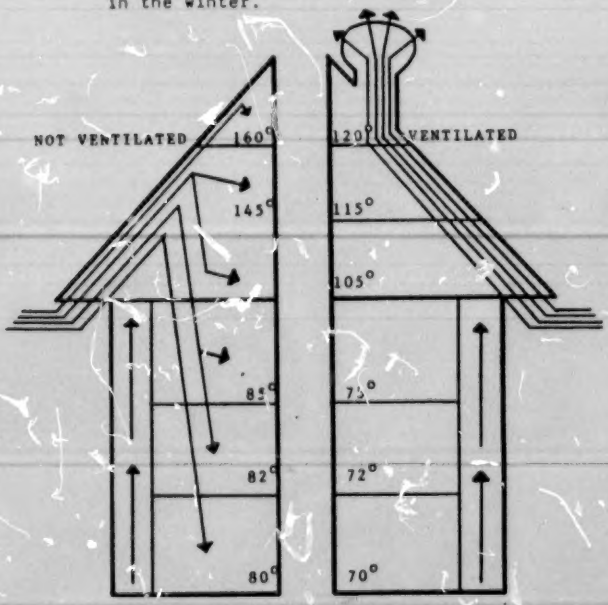
   A. Explain how exfiltration can be caused by too much make-up air being taken in from outside.

3. AIR CHANGES

   A. For comfort cooling a number of air changes are needed to insure fresh air. Use ASHRAE Guidelines.

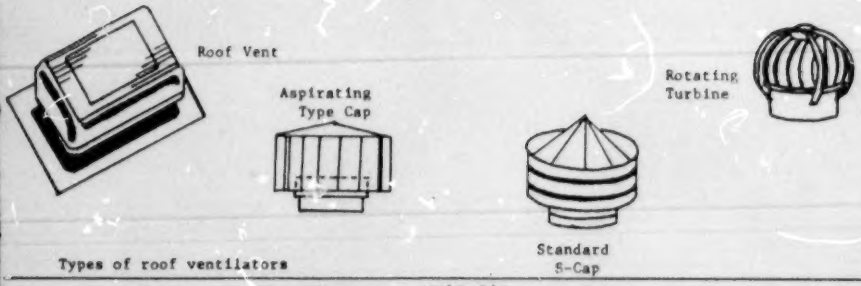
4. ATTIC VENTILATION

A. Fan-forced ventilation using thermostatic control.
B. Roof ventilators where you have no gable ends.
C. Eave vents.
D. Explain why ventilation is important in removing heat in summer and possible moisture in the winter.



5. Make-up air

A. All fossil-fuel-burning appliances use oxygen for combustion. Thus, ventilation is required.
B. All fossil-fuel-burning appliances vent combustion products to the outside and need additional air to assist dilution and aid venting.



Types of roof ventilators

UNIT III

VENTILATION SUPPLEMENT

THE PURPOSE OF GAS APPLIANCE VENTING (taken from Fundamentals of Venting and Ventilation).

A properly designed and installed appliance venting and ventilation system will serve the following important purposes:

1. Convey all of the hot combustion gases to the outside atmosphere.
2. Protect the building structure from fire hazards due to overheating walls or other surfaces.
3. Prevent damage to walls and furnishings due to the escape and condensation of hot combustion gases.
4. Provide for good air circulation and adequate oxygen supply for the appliance and for the occupants of the home.

To understand the job a venting system must do, it is helpful to consider the quantities of gases that must be exhausted through it. If 100 cubic feet of natural gas are burned in an appliance, about 1000 cubic feet of air are needed. The hot combustion products will consist of 100 cubic feet of carbon dioxide, 200 cubic feet of water vapor and 800 cubic feet of nitrogen.

The nitrogen is what is left of the air after the oxygen is burned. The 200 cubic feet of water vapor amounts to about one gallon of water if condensed. Because the combustion reaction is not 100 percent efficient, more air than actually needed is supplied. This excess air, about 250 cubic feet, is heated and mixed with the combustion products. Thus, to burn 100 cubic feet of gas about 1250 cubic feet of air is needed. The total products of combustion will amount to 1350 cubic feet which the vent system must convey outdoors. See figure 1.

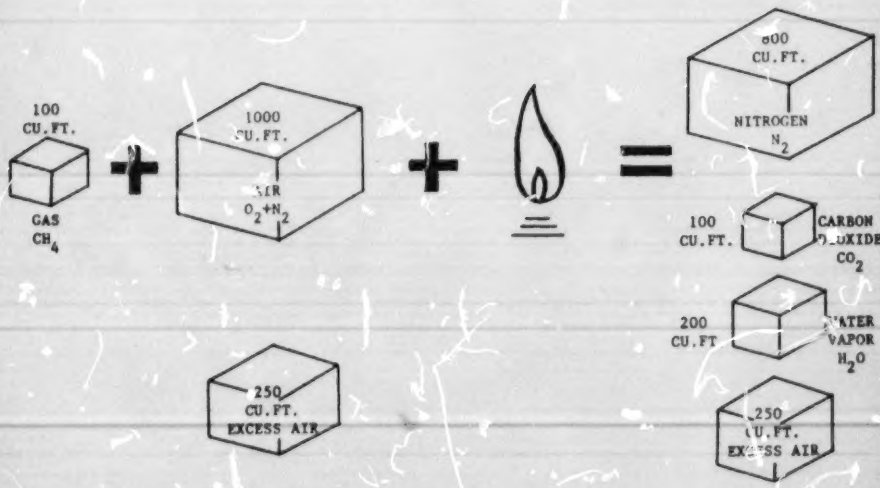


Fig. 1. Combustion of natural gas. LP gases produce the same combustion products in differing proportions.

BASIC THEORY OF VENTING SYSTEM OPERATION

A chimney or vent system operates because there is a draft in the system. Draft is the force that draws the combustion products up the chimney. This draft is created by the fact that hot air in the vent is lighter than the cool air that surrounds it.

As discussed previously, the combustion products resulting from burning natural gas contain considerable water vapor. Approximately one gallon of water is formed when burning 100 cubic feet of gas. This amount of water will be made in only 1 hour by a 100,000 BTU per hour size furnace. If water vapor was allowed to condense inside the house over a period of time, it would cause considerable damage to walls, furniture and other household contents. The heat of combustion will maintain the water in the form of vapor and cause all the flue products to pass up the vent to the outside atmosphere. Water vapor at high temperature is a gas. It only becomes visible as liquid after it has been cooled below its dew point. Thus, a vent passes the water vapor to the outside atmosphere where condensation, if it occurs, is not harmful.

UNIT ACTIVITIES

1. Have students check residential structures for proper ventilation and weatherization.
2. Perform a complete home energy audit in conjunction with Unit II and make recommendation based on the data collected.

REFERENCES

Nebraska Energy Saving Manual 50¢ per copy
Nebraska Energy Office
Box 95085
Lincoln, NE 68509

From Dura-Vent Corpoeration
2525 El Camino Real
Rewood City, CA 94064

1. How to Install a Safe Chimney System
2. Tips on Chimney Care and Safety

FILMS/AUDIO VISUAL AIDS

Ventilation, Make-up, and Combustion Air
Carrier Training Aids
Check for availability through loca Carrier dealers.

Home Weatherization: Skill Training Series
Midlands Energy Institute and Nebraska Energy Office
Check for availability through your Community College Area Media Services.

UNIT IV

AIR-CONDITIONING

RATIONALE

This unit is designed to provide the student with information concerning various ways to conserve energy with regard to cooling. This will include a discussion of present and future cooling appliances.

ADVANCED PREPARATION

It is recommended that the publication "Nebraska Energy Saving Manual" be obtained from the Nebraska Energy Office prior to beginning this unit.

The accessability of a central air-conditioner is essential since the activities contained within this unit require many "hands-on" tasks.

ANTICIPATED INSTRUCTIONAL TIME

1-3 days

UNIT GUIDE

1. Service an A/C Unit according to manufacturers' specifications

   A. Clean outside condensor on air-cooled units.
   B. Check water temperature across water-cooled condensors, and delime if temperature change is insufficient.
   C. Clean evaporator surface.
   D. Oil all motors.
   E. Clean all fans.
   F. Adjust belt tension and fan speed.
   G. Clean or replace air filters.

2. Duct sizing

   A. In residences, ducts for air cooling should be sized to move approximately 400 CFM per ton. (Refer to ASHRAE Standards)

3. Unit Sizing

According to the Better Heating-Cooling Council:

"Central home air conditioning can provide good comfort if it is sized to do its job. Oversizing by even one step, using a 3-ton unit instead of a 2 1/2, for example, can cause discomfort and higher electric bills.

An oversized unit affects the thermostat too quickly, before the cooling system has the chance to remove unwanted summer humidity. The cool air temperature at the thermostat turns off the unit, but the humidity is still there, causing that dank, sweaty feeling.

Smaller units have smaller motors; they will operate longer than oversized units, but will give more comfort and use less electricity."

A. Calculate the heat gain of the structure.
B. Since a unit dehumidifies more efficiently if it is slightly undersized - recommend accordingly.

4. Thermostats

A. Proper location so that it does not become affected by solar radiation and other heat sources.
B. Check thermostat and adjust if necessary. Explain the thermostat's proper operation to the customer to meet their needs (with energy conservation in mind).

5. Heat Pumps - Cooling Mode

A. Heat pumps are glorified air conditioners, modified to reverse themselves in winter. They should be sized for the summer cooling load, otherwise they cannot provide summer comfort in humid areas.
B. Water-to-air heat pumps rely on surface water or wells for their cooling and heating. If there is a pond of clean water at the right temperature nearby, tapping it can reduce electric bills for cooling and heating, better than the air-to-air heat pump, and with less service problems.
C. If the heat pump instructions say to change the air filter every month, do so! Reduced air flow over the cooling coil adversely affects the refrigerant, and when it is pumped out to the compressor it may cause expensive damage.
D. A two-stage compressor in a heat pump automatically adjusts itself to the load - single stage for light loads and both stages for heavy loads, in winter and summer. With less strain, there is lower use of electricity and longer compressor life.

UNIT ACTIVITIES

1. Service a central air conditioner:
   A. Clean condensor
   B. Clean evaporator coils
   C. Clean fans
   D. Change filters
   E. Oil all motors

2. Measure the temperature across the coil and make adjustments according to manufacturer's specifications.

3. Determine the best heat pump installation for a single residence.
   A. Air-to-air
   B. Water-to-air

UNIT REFERENCES

The following titles can be obtained from:

Nebraska Energy Office
Box 95085
Lincoln, NE 68509

1. The Nebraska Energy Saving Manual
2. Energy Conservation with Heat Pumps

Other References:

Energy:

Alliance to Save Energy, June 1980
1925 "K" Street, N.W.
Suite 507
Washington, D.C. 20006

Air Conditioning
Total Home Comfort Planning Series - Book 2
Honeywell Corporation
Department #118
2701 Fourth Avenue South
Minneapolis, MN 55408

ASHRAE-Standards Manual

UNIT V

NEW APPLIANCE PURCHASING

RATIONALE

The Appliance Labeling Program is designed to help consumers shop for energy-saving household appliances and equipment. It is being developed by the Department of Energy and the Federal Trade Commission as a result of the Energy Policy and Conservation Act, signed into law on December 22, 1975.

Under that law, manufacturers must place labels showing estimated annual operating costs on all models of the following:

-Central air-conditioners
-Clothes dryers
-Clothes washers
-Dishwashers
-Freezers
-Furnaces
-Home heating equipment, excluding furnaces
-Humidifiers and dehumidifiers
-Kitchen ranges and ovens
-Refrigerators and refrigerator -freezers
-Room air conditioners
-Television sets
-Water heaters

The student who becomes a practicing HVAC technician will undoubtedly, with the advent of this program, encounter an uninformed and confused public. This unit, therefore, is designed to provide the student with information concerning energy efficiency standards as they apply to new appliance purchases.

ADVANCED PREPARATION

It is recommended that the publications, Nebraska Energy Saving Manual and Appliance Labeling be obtained from the Nebraska Energy Office prior to beginning this unit.

ANTICIPATED INSTRUCTIONAL TIME

1-2 days

UNIT GUIDE

1. Evaluate your needs and lifestyle prior to making an appliance purchase. A window air-conditioner, for example, may better suit your needs than would a omplete central-air system. A window air-conditioner saves energy, money, and initial investment cost.

2. Size the appliance to fit the job.

   A. Have a heat loss and gain calculation performed on the dwelling.
   B. See Unit IV, Section 3, for rationale.

3. Study labels - "Energy Efficiency Ratings" should be printed on the unit. They are:

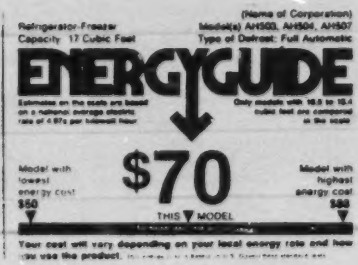
   A. EER (Energy Efficiency Ratio): A measure of how efficiently an air-conditioner uses electricity. The EER is shown as a number, usually between 7 and 12, for units of the same capacity. The higher the EER number, the more efficient the unit.
   B. COP (Coefficient of Performance): A ratio of BTU's gained from heat pump use compared to heat gained from direct resistance heating.
   C. EYOC (Estimated Yearly Operating Cost): This will give you an approximation of the cost of running an air-conditioner during the cooling season. The label should carry the wattage as well as the model number of the air-conditioner.
   D. SPF (Seasonal Performance Factor): This is the ratio of the annual heat delivered to the annual electrical energy input.

4. Compare initial cost versus life cycle cost.

   Wise consumer purchasing in an era of energy conservation requires that you bring a new dimension of value to your buying decisions. Often times an appliance that costs less to but initially, will cost you more to operate over its lifetime. Similarly, an appliance that costs more initially, costs less to use and helps pay for itself in energy savings.

5. Calculating payback

   Consult trained technicians, resources listed below or other available sources.


(Name of Corporation)
Refrigerator-Freezer
Model(s) AH503, AH504, AH507
Capacity 17 Cubic Feet
Type of Defrost: Full Automatic
ENERGYGUIDE
Estimates on the scale are based on a national average electric rate of 4.97¢ per kilowatt hour
Only models with 16.5 to 16.4 cubic feet are compared to the scale
Model with lowest energy cost
$70
Model with highest energy cost
$50
THIS MODEL
$90
Your cost will vary depending on your local energy rate and how you use the product.

Look for the ENERGYGUIDE label when you purchase or recommend major home appliances. Follow these appliance tips to save even more energy and money on presently owned or new appliances:

WATER HEATER: Lower the hot water temperature to 105°F. (or 140°F) with dishwashers. Purchase and install a water heater insulation kit. Turn thermostat down or turn electricity off when on vacation.

CLOTHES WASHERS: Heating water accounts for 95 percent of the energy consumed for hot-water washing. Save money by washing full loads in cold water. Always use cold-water rinse.

DISHWASHERS: A dishwaster consumes the same amount of energy whether washing a full or small load. Save by washing only full loads.

FURNACES: Save 9-15 percent by turning down thermostat at night; changing or cleaning filters regularly; closing drapes at night; servicing annually (in full); sealing house against leaks.

REFRIGERATORS-FREEZERS: More economical when full; don't leave door open; cool hot food before putting in; keep coils clean.

FREEZERS: More economical when full; remove frost buildup regularly; keep coils clean; chest freezer 15 percent more efficient than an upright.

HEAT PUMPS: Set at 78° in summer and 65° in winter; service annually; change or clean filters regularly; seal house against leaks; during the winter, don't turn the thermostat down at night.

ROOM AIR-CONDITIONERS: Change or clean filter monthly; use fan only when adequate, otherwise set thermostat at warmest comfortable setting; close drapes to block direct sunlight.

UNIT ACTIVITIES

Have students check and compare ratings on several appliances and make recommendations for purchase, based on:

1. Personal needs
2. Site location
3. Room size
4. Energy efficiency ratings

UNIT REFERENCES

The following publications may be obtained from the:

Nebraska Energy Office
P. O. Box 95085
Lincoln, NE 68509

1. Nebraska Energy Saving Manual
2. Energy Conservation with Heat Pumps
3. How to be a Wise Energy Buyer
4. Tips for Energy Savers

Other sources:

1. ASHRAE-Standards Manual

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